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Indian Standard

METHODS OF MEASUREMENT OF COLOUR TELEVISION PICTURE TUBES

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NEW DELHI 110002

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Indian Standard

METHODS OF MEASUREMENT OF COLOUR TELEVISION PICTURE TUBES

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*Shri K. R. Savoor was the chairman for the meeting in which the standard was finalized.

(*Continued on page* 2)

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(*Continued from page* 1)

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Indian Standard

METHODS OF MEASUREMENT OF COLOUR TELEVISION PICTURE TUBES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 16 February 1983, after the draft finalized by the Electron Tubes Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard deals with the methods of measurement for colour television picture tubes.

0.3 Methods of measurements of monochrome television picture tubes are covered by IS : 4579-1968*.

0.4 While preparing this standard, assistance has been derived from IEC Pub 151-28 'Measurements of the electrical properties of electronic tubes Part 28 : Methods of measurement of colour television picture tubes' issued by the International Electrotechnical Commission.

0.5 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960†.

1. SCOPE

1.1 This standard covers the methods of measurement for colour television picture tubes with their electron beams and shadow mask.

2. TERMINOLOGY

2.0 For the purpose of this standard, the definitions given in IS : 1885 (Part IV/Sec 4)-1970‡ shall apply in addition to the following.

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*Method of measurements on television picture tubes.

†Rules for rounding off numerical values (*revised*).

‡Electrotechnical vocabulary : Part IV Electron tubes, Section 4 Cathode-ray tubes.

2.1 Stray Emission — Uncontrolled electron emission that causes undesired luminance on the screen of a cathode-ray tube under cut-off conditions.

2.2 Cathode Emission — The electron emission from the cathode measured in electron current at the specified operating conditions.

2.3 Beam Trio — The electron beam trio which passes through the same shadow mask aperture.

2.4 Purity Shift — The register movement at the centre of the screen, with respect to a phosphor trio, when the strength of the purity magnetic field is reduced, from the value which gives the optimum register, to zero.

2.5 Raster Centring Displacement — The horizontal and vertical distance between the geometrical centre of the tube face and the just visible focused spot when the deflecting and centring currents are cut off.

2.6 Static Convergence — To converge the three beams at the centre of the screen by converging the three beams at the same spot in the plane of the screen.

2.7 Dynamic Convergence

To converge the three beams at any point on the entire screen:

a) by varying the magnetic fields derived from the scanning circuits, or

b) by adjusting the position of the deflection yoke in the case of a self-converged system.

2.8 Radial Convergence Shift (For Delta Gun Arrangement) — The radial displacement of the red, green and blue electron beam spots from their point of convergence in the centre of the screen when the three static radial convergence magnetic fields are all reduced to zero strength.

2.9 Lateral Convergence Shift (For Delta Gun Arrangement) — The lateral displacements between the blue beam spot and the converged red and green beam spots at the centre of the screen when the strength of the lateral convergence magnetic field is reduced to zero.

2.10 Horizontal Convergence Shift (For-in-Line Gun Arrangement) — The horizontal displacements of the outer beams from the centre beam when the two convergence fields are reduced to zero.

2.11 Vertical Convergence Shift (For-In-Line Gun Arrangement) — The vertical displacements of the outer beams from the centre beam when the two convergence fields are reduced to zero.

2.12 Outer Beam Convergence Shift (4-Pole Correction : For-In-Line Gun Arrangement) — The vertical and the horizontal displacements of the outer beams from the initial convergence point when the two convergence fields are reduced to zero.

2.13 Centre Beam Convergence Shift (6-Pole Correction : For-In Line Gun Arrangement) — The displacement of the converged outer beams from the centre beam when the two convergence fields are reduced to zero.

2.14 Anode Current For White Light Output — The sum of the red, green and blue anode currents which are required to provide a white light output of specified luminance and chromaticity co-ordinates at the screen centre with the best focusing voltage, and under such conditions that the white unblanked raster size corresponds with the specified useful screen dimensions.

2.15 Current Ratios For White Field — The ratio of red to green, red to blue, and blue to green anode currents required to produce the white field designated in **2.14**.

2.16 Uniformity — Uniformity of the chromaticity and the brightness of a designated raster over the entire screen.

2.17 Useful Screen Dimensions — The dimensions of the part of the luminescent screen, visible when viewing in the direction of the tube axis.

2.18 Screen Blemish — The luminescent screen blemish exclusive of faceplate blemish as found on the useful screen under operating or non-operating conditions.

2.19 Faceplate Blemish — The glass blemish on the useful screen, for push through picture tubes; faceplate blemishes may be extended to the non-useful visible part.

2.20 Limiting Resolution — Maximum number of lines which can be discerned per picture height.

2.21 Register — The relative position of the beam trio with respect to the associated phosphor dot or line trio.

2.22 Degaussing — The process of applying a strong alternating magnetic field, and slowly removing that field, in order to provide a built-in correction for the register error caused by the earth's field and/or other stray magnetic fields.

3. MEASUREMENT CONDITIONS

3.1 General

3.1.1 The colour picture tube shall be assembled with the specified deflection yoke, convergence components, purity component and, if necessary, a magnetic shield.

3.1.2 The specified operating voltage shall be supplied to each electrode and electrical signals shall be applied to achieve the following conditions:

a) Anode voltage: (constant, all tests);

b) Best centre focus, by adjusting the voltage of the focus electrode; and

c) Full scan of luminescent screen area, plus 10 percent overscan unless otherwise specified.

3.2 Degaussing

3.2.1 Before starting a measurement, the tube and its magnetic shield (if any) shall be degaussed in the position in which measurements will take place. This shall be done using a suitable coil, carrying a high ac current which is then slowly cut off.

NOTE — When necessary, the tube should be brought into such a position or so immersed in a compensating field that the earth's magnetic field will have no influence on the measurement.

3.3 Adjustment Procedure

3.3.0 Unless otherwise stated by the manufacturer, the following adjustment procedure shall be applied.

3.3.1 Using a cross-hatch or dot signal, the convergence of red, green and blue beams shall be adjusted in the centre of the screen with the static convergence components.

3.3.2 The blue and green beams (in case of the delta type tube), or the outer beams (in case of the in-line tube) shall be cut off.

With a blank raster and the yoke positioned either in the most forward or most rearward position (depending on the specific yoke/tube combination) the direction and strength of the purity magnetic field shall be adjusted until a uniform colour zone is achieved in the central area of the screen. Then the deflection yoke shall be moved axially to obtain the most uniform raster over the entire screen. The beams shall be reset which were initially cut off.

The convergence shall be readjusted as outlined in **3.3.1.** The register shall be adjusted for its optimum condition at the centre of the screen, preferably with the help of a microscope.

3.3.3 The raster shall be centered, horizontal and vertical linearity and raster size shall be adjusted to the specified useful screen dimensions.

3.3.4 The static and dynamic convergences shall be adjusted.

3.3.5 Adjustment of static and dynamic convergences shall be repeated to obtain the best possible compromise.

The purity adjustment shall be checked, readjusted and if required repeat after 10 min running at half of the maximum beam current.

4. METHODS OF MEASUREMENT

4.1 Heater Current

4.1.1 The rated voltage shall be applied to the heater. The current shall be measured when thermal equilibrium is reached after a preheating time of at least 5 minutes. During the measurement, no voltage shall be applied to any other tube-elements and they may be left floating unless otherwise stated.

4.2 Heater-cathode dc Leakage Current

4.2.1 For tubes having unipotential cathodes not connected to the heater within the tube the rated heater voltage shall be applied to the heater terminals. The potential of any part of the heater shall not be less than the specified voltage with respect to the cathode.

4.2.2 The heater-cathode leakage current shall be measured when thermal equilibrium is reached after the preheating time of at least 5 minutes.

4.3 Electrode Leakage Current

4.3.1 With cathode at cut-off bias the leakage current between the specified electrodes shall be measured when thermal equilibrium is reached after the preheating time of at least 5 minutes.

NOTE — To obtain the correct measuring results, subtract the leakage of the measuring equipment from the measured leakage current.

4.4 Flashover

4.4.1 The tube shall be placed in a given circuit, with stated voltages applied. The number of flashes observed on the face of the tube during a given time shall be measured.

4.5 Stray Emission

4.5.1 The tube under test shall be placed in a given circuit, with stated voltages including a cut-off voltage and deflection voltage applied.

The ambient illumination shall not exceed 5 lx when measured at the screen of the tube. The observer shall have adapted his eyes before observing the screen of the tube.

4.6 Focusing Voltage

4.6.1 The tube under test shall be set up as described in **3**. The tube shall be placed in a given circuit including the deflection system, with specified voltages applied.

4.6.2 A suitable signal to the modulation electrode in order to obtain a defined pattern shall be applied.

4.6.3 The beam current (final electrode current) shall be adjusted to the specified value after thermal equilibrium conditions are reached. As an alternative, measurements can be made with a pulsed spot. The ambient illumination, measured at the screen of the tube, shall not exceed 5 lx.

4.6.4 The voltage on the focusing electrode shall be adjusted to obtain the best focus of the pattern at a specified portion of the screen. The voltage on the focusing electrode obtained under the above conditions is measured. The measurement shall be carried out for each gun in turn.

4.7 Cut-off Voltage

4.7.1 The tube under test shall be set up as described in **3**. The cut-off voltage shall be measured. The ambient illumination falling on the screen shall be at a low level with a maximum of 1 lx.

4.7.2 Alternatively, the voltage measured at a stated low beam current (typically 0·1 μA) could be used as cut-off voltage.

4.7.3 Special care shall be taken since it is sometimes difficult to distinguish the beam current from the leakage current. The measurement is carried out for each gun in turn.

4.8 Cathode Emission — *See* IS : 4147-1981*.

4.8.1 The tube shall be operated under stated conditions. Grid No. 1 of the gun under test shall be connected to cathode and the cathode current shall then be measured. The measurement shall be carried out for each gun in turn.

NOTE 1 — The above condition shall not be maintained for more than 10 s at a time since permanent damage to the tube may result otherwise.

NOTE 2 — During the measurement, the other two beams shall be set at cut-off conditions.

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*Method of measurements on conventional receiving electron tubes (*first revision*).

4.9 Purity Shift

4.9.1 The tube under test shall be set up as described in **3**. The purity shift shall be measured.

4.10 Raster Centring Displacement

4.10.1 The tube under test shall be set up as described in **3**. The raster centring displacement shall be measured.

4.11 Radial Convergence Shift (For Delta Gun Arrangement)

4.11.1 The tube under test shall be set up as described in **3**. The radial convergence shift shall be measured.

4.12 Lateral Convergence Shift (For Delta Gun Arrangement)

4.12.1 The tube under test shall be set up as described in **3**. The lateral convergence shift shall be measured.

4.13 Horizontal Convergence Shift (For In-Line Gun Arrangement)

4.13.1 The tube under test shall be set up as described in **3**. The horizontal convergence shift shall be measured.

4.14 Vertical Convergence Shift (For In-Line Gun Arrangement)

4.14.1 The tube under test shall be set up as described in 3. The vertical convergence shift shall be measured.

4.15 Outer Beam Convergence Shift (4-Pole Convergence Shift: For In-Line Gun Arrangement)

4.15.1 The tube under test shall be set up as described in **3**. The outer beam convergence shift shall be measured.

4.16 Centre Beam Convergence Shift (6-Pole Convergence Shift: For In-Line Gun Arrangement)

4.16.1 The tube under test shall be set up as described in **3**. The centre beam convergence shift shall be measured.

4.17 Anode Current for White Light Output

4.17.1 The tube under test shall be set up as described in **3** and **2.14**. The anode current shall be measured for white light output.

4.17.2 The sum of these currents is expressed as:

$$I_a = I_{ar} + I_{ag} + I_{ab}$$

where

I_{ar} = anode current of a red solid field,
I_{ag} = anode current of a green solid field, and
I_{ab} = anode current of a blue solid field.

4.18 Current Ratios for White Field

4.18.1 The tube shall be measured as described in **4.17** and the current ratios shall be calculated according to the following formulae:

$$\frac{\text{Red current}}{\text{Green current}} \qquad \frac{I_{ar}}{I_{ag}}$$

$$\frac{\text{Red current}}{\text{Blue current}} \qquad \frac{I_{ar}}{I_{ab}}$$

$$\frac{\text{Blue current}}{\text{Green current}} \qquad \frac{I_{ab}}{I_{ag}}$$

4.19 Chromaticity and Colour Spectral Characteristic

4.19.1 That tube shall be operated as described in **4.17**. The chromaticity and colour spectral characteristic of each colour shall be measured by a colorimeter or spectroradiometer.

4.20 Uniformity

4.20.1 The tube shall be operated as described in **4.17**. The quality of the white, red, green and blue uniformity shall be evaluated with the naked eye at the designated distance (normally three times the picture diagonal) from the tube screen. The ambient illumination, measured at the face of the tube, shall be approximately 5 lx.

4.21 Screen and Faceplate Blemish

4.21.1 The tube shall be operated as described in **4.17**. The screen blemish on red, green, blue and white fields shall be viewed at a minimum distance of 60 cm.

4.21.2 The ambient illumination, measured at the face of the tube, shall not exceed 5 lx.

4.21.3 In the non-operating condition, the faceplate blemish may be observed under high-level incandescent light of 700 lx to 1 000 lx at the faceplate surface.

4.22 Resolution

4.22.1 The tube to be measured shall be set up as described in **3**. The specified video test pattern shall be applied and the focus voltage adjusted for the best balance of vertical and horizontal resolutions at a specified portion of the screen.

4.22.2 Vertical and horizontal resolution shall be measured on the white, red, green and blue fields in the centre and on the edges of the screen.

4.23 Capacitance Between External Conductive Coating and Anode

4.23.1 The capacitance between the external conductive coating and anode shall be measured in accordance with the method described in IS : 4147-1981*.

4.24 Gas-content Factor

4.24.1 The gas-content factor shall be measured using the method described in **9** of IS : 4579-1968†.

5. PRECAUTIONS

5.1 External influences on the magnetic characteristic of the tube should be eliminated.

5.2 Electron bombarment on the neck due to extreme adjustments of the beam should be avoided.

5.3 When measuring the raster centering displacement, the current shall be reduced to a very low level to avoid damage of the shadow mask and screen.

5.4 The pre-heating time shall be such that the internal dimensions of the tube structure are not appreciably altered by longer heating.

5.5 Grounding of external coating of the picture tube and the metal casing on the sides of the picture tube should be ensured.

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*Method of measurements on conventional receiving electron tubes (*first revision*).

†Methods of measurements on television picture tubes.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1}).
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2